

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
Bureau of Agricultural and Industrial Chemistry
Eastern Regional Research Laboratory
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FIRMING APPLE SLICES

The discovery that calcium chloride exerts a firming action on apple tissue was first disclosed in a publication by Dr. Z. I. Kertesz of the New York Agricultural Experiment Station (*The Canner*, vol. 88, p. 26 (1939)). Although Kertesz pointed out the practical applications of the calcium treatment in canning and freezing, apparently no further development of the process was made at that time. About a year ago Powers and Esselen of the Massachusetts Agricultural Experiment Station published (*Fruit Prod. J.*, p. 200, March 1946) on the use of calcium chloride for firming McIntosh apple tissue. They treated the slices by either dipping or cooking in calcium chloride solution. For frozen slices they also added calcium chloride to the sirup covering the slices.

Shortly before the Powers and Esselen article appeared in print, the Bureau of Agricultural and Industrial Chemistry's Eastern Laboratory had begun a study of this problem of firming apple slices. We have successfully firmed apple slices by two methods: (1) a modification of the Massachusetts State calcium method; and (2) an enzyme method involving the use of a mixture of pectase and calcium salt. The calcium method appears to be more widely applicable and easier to use than the enzyme method. For these reasons studies have been concentrated on the calcium method for firming apple slices.

The following procedures for firming fresh, canned, or frozen apple slices require only slight modifications in the usual methods of preparation. The apples are first peeled, cored, and sliced. If a delay is necessary at any point between peeling and subsequent steps in processing, the apples should be held in a weak salt brine (0.1 to 1.0% by weight) to prevent browning.

Fresh Slices: The recommended procedure for firming fresh apple slices is to dip them in a dilute solution of calcium chloride. The concentration of calcium solution may vary from 0.1% to 1.0% and the dipping time may vary from a few minutes to one hour. In most cases a 2 to 10 minute dip in 1.0% calcium chloride solution is satisfactory. With very soft apples it is often desirable to allow them to stand several hours after dipping so that the calcium may diffuse into the center of the slices.

Canned Slices: It has been observed that canned slices which had been firmed by a calcium chloride dip showed case-hardening (non-uniform firming) at first but that this condition disappeared after about 2 months storage. Apparently the calcium migrates slowly to the interior of the slice.

If the slices have been deaerated prior to canning, they may be firmed by adding the calcium solution to the can. In this case 1 or 2 ounces of a 1% calcium chloride solution may be sufficient for a No. 10 can of sliced apples. Some plants use a combination evacuation and steam blanching process which is an economical method of pretreating slices to eliminate air and fill them with water.

Frozen Slices: The following procedure may be used to firm slices which are to be frozen: Blanch the slices with steam for a sufficient time (usually 1-1/2 to 2 minutes) to prevent browning. Then dip the blanched slices in a cold water bath containing 0.5 to 1.0% calcium chloride. The calcium chloride cooling solution also may be applied as a spray. The time of contact with the calcium chloride solution may vary from 2 to 20 minutes, and should be long enough to remove the excess heat from the slices. It is advisable on a commercial scale to cool and recirculate the calcium chloride solution.

Slices to be frozen are also commonly dipped in dilute sulfurous acid (or sodium sulfite) solution to prevent browning after thawing. In this case the calcium chloride may be added to the dipping solution. The concentration may vary from 0.2 to 1.0% depending on the time of contact with the solution and the extent of firming desired.

Discussion: Studies were made on summer and early fall varieties as follows: Yellow Transparent, Williams, Rambo, Gravenstein, Star, Wealthy, McIntosh, Smokehouse, Jonathan, Golden Delicious, Red Delicious, Stayman Winesap, Rome Beauty, and York Imperial. It was possible to firm adequately each of these varieties of apples for use in pie baking. On the basis of these results it would be expected that any other variety could be firmed with calcium chloride.

The extent of firming treatment to be given any particular lot of apples will depend upon the variety, stage of maturity, and method of processing. The concentration of calcium chloride to use to attain the desired degree of firmness can best be determined by making a few small scale tests using different concentrations of calcium. If the slices are to be used for pie baking, it would be advisable actually to bake the treated samples into pies and judge the appearance and texture of the baked slices.

NOTES: The use of calcium salts for firming canned tomatoes was approved by the Food and Drug Administration in 1940, but up to the present time there has been no official ruling on the use of calcium salts for firming apple slices. If calcium salt is added to fresh, canned, or frozen apple slices, this fact must be declared on the label.

Further information on the processing of apples will be furnished on request by the Eastern Regional Research Laboratory of the U. S. Department of Agriculture, Chestnut Hill Station, Philadelphia 18, Pa.